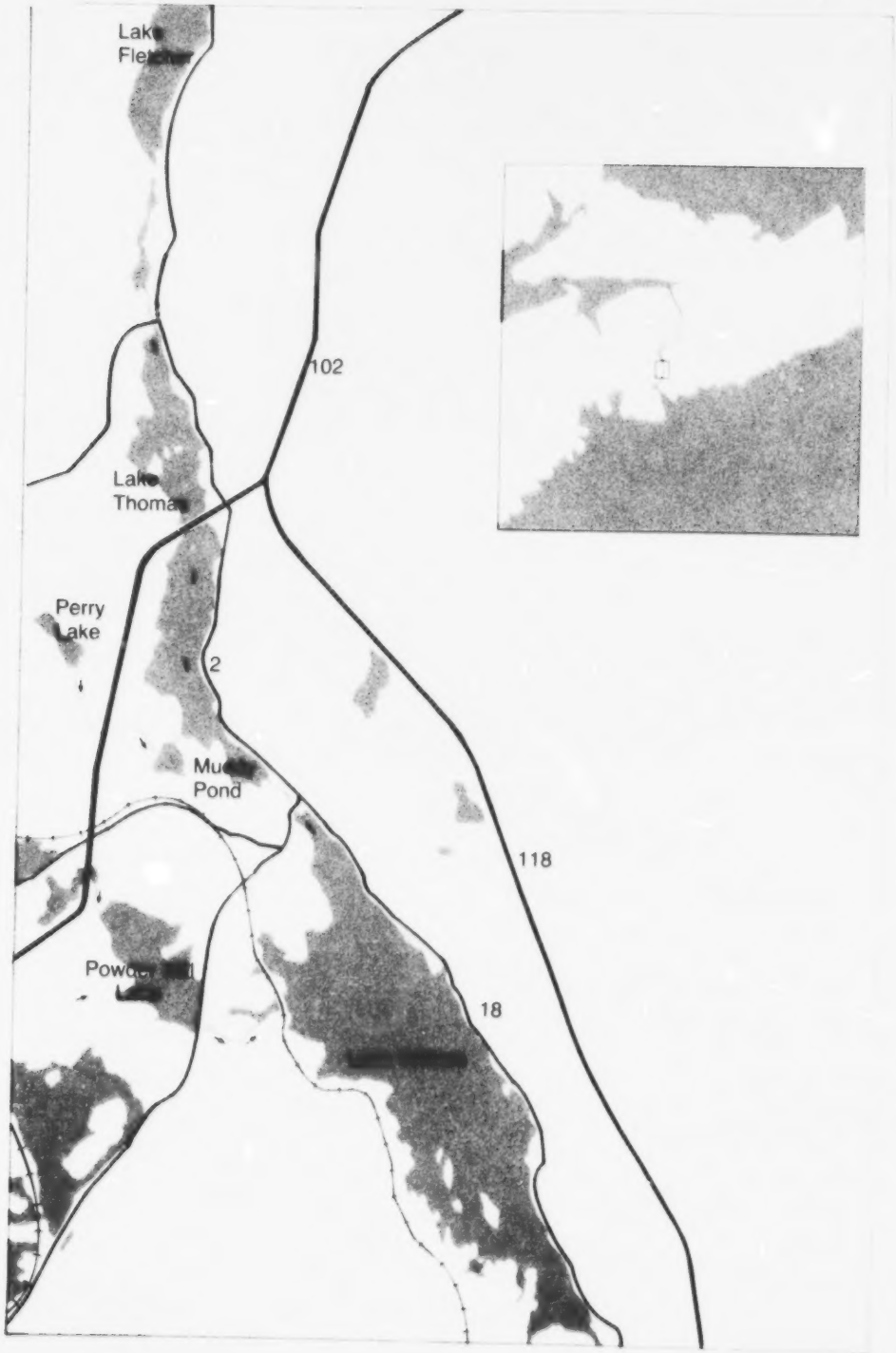
85-6588/



Introduction

Over the past few years, arsenic contamination of well water has occurred at a number of locations in the Shubenacadie headwater lakes area. One source of the arsenic problem is known to be tailings piles from gold mines which were in use between the 1860's and 1930's. Though the problem of contaminated drinking water is being alleviated by treated municipal water supplies, much remains to be learned in the Waverley area about environmental pathways followed by arsenic and other metal contaminants in basins.

In 1983-84, a joint federal-provincial working group set out to study the levels and pathways of metal contaminants in surface waters of a 31 km^2 area near Waverley which included lakes William, Thomas, Fletcher, Perry, Three Mile and Powder Mill, and Muddy Pond, as well as their interconnecting streams. The object was to determine the sources of metal contaminants, their concentrations in various components of the environment and their ultimate fates. The concentrations were determined in water, suspended matter, sediments and fish. The chemical and physical conditions in the lakes and connecting streams were also studied as it was perceived that they could have an indirect affect on contaminant levels.

The root of the arsenic problem in the Waverley area is the bedrock as it contains arsenopyrite mineralization along with gold. A number of man's activities have resulted in exposure of the arsenopyrite to oxidization processes, though the crushing of rock for the extraction of gold has probably had the most significant impact on the environment in the study area.

Another metal contamination problem was caused by the mercury amalgamation process which was used to extract the gold from the crushed rock. An estimated 1000 kg of mercury was lost through the extraction during mining operations.

Other metals were also studied but these two were the only ones which occurred in concentrations significant enough to warrant in-depth examination.

Study Results

Metal distribution in the lakes and sediments showed an interesting pattern. Mercury was not found in any water sample, while the arsenic levels detected were within 1978 Drinking Water Guidelines although the outlet stream of Muddy Pond, where it empties into Lake Thomas near the swimming beach contained concentrations of arsenic which were up to 5 times higher than at any other site in the study area, and very close to the maximum acceptable concentration recommended.

The greatest metal contaminant concentrations in the basin were in lake bottom sediments. Work done in 1977 found arsenic, mercury, lead and zinc in the sediments of Muddy Pond, Lake Thomas and in Lake Fletcher, with Muddy Pond containing some of the highest arsenic values measured in Canada. In 1983, unusually high levels of mercury and arsenic were also measured in the sediments of a previously unsampled site at Powder Mill Lake. An analysis of mercury levels in its sediment indicates high values in the top 8 cm suggesting a continuous input of mercury into the lake over the last 100 years. No tailing piles have been identified in Powder Mill Lake basin although fine, yellow sands near the most northerly inlet are suspected of being water transported tailings. Further, historical documents show that an explosives manufacturing plant, using mercury compounds was located near the lake in the late 19th century. Both sources have probably contributed to the observed mercury concentrations although the relative importance of each is unknown.

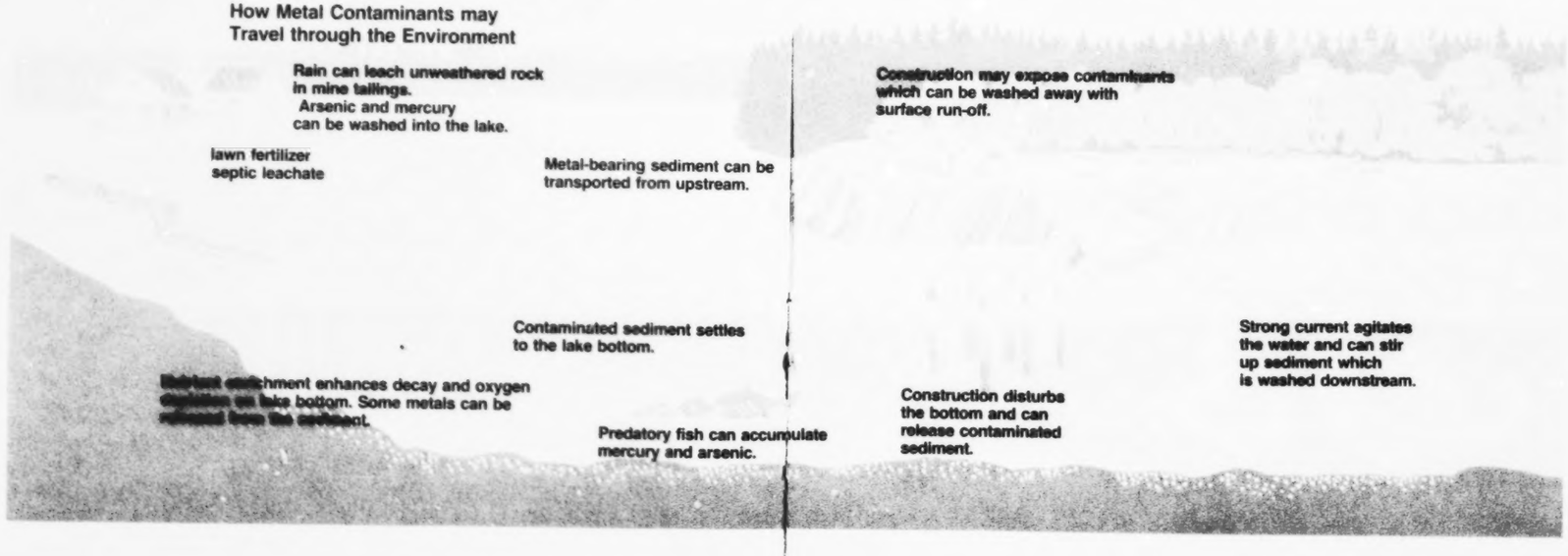
A number of activities such as disturbance by machines, waves, and currents, can cause resuspension of sediments into the water column. The present work has estimated that 33 kg of arsenic and 13 g of mercury were moved from Muddy Pond into Lake Thomas in 1982-83 while 8.6 kg and 20 g of arsenic and mercury respectively were transported on suspended particles from Powder Mill to Lake William, which empties into Lake Thomas. Similar amounts were transported from Lake Thomas to Lake Fletcher. Thus the general trend in the Shubenacadie lakes system seems to be that metal contaminants are transported downstream on sediment particles which originate from the two contaminated lakes.

. The significance of high metal values in sediments and suspended matter is still unclear. A preliminary study of metal concentrations in fish revealed levels of Hg in fish from Lakes Thomas, Powder Mill and William up to four times higher than the federal Health Protection Branch administrative Guideline for fish for human consumption, with the highest values being found in white perch. Because no other components of the biota were studied, nor were the fish collected in high enough numbers for a thorough analysis of species and size differences, additional studies will be conducted over the next 2 years to ascertain the significance of these results.

The work group also identified a number of sites containing waste rock from mining operations which were high in "leacheable" arsenic. Development of these areas should proceed with caution so that additional leaching of contaminants is minimized.

In conclusion, this study shows that arsenic and mercury are being transported through the upper Shubenacadie lakes system by suspended solids. The main areas of concern are in Muddy Pond and its outlet which is near a public swimming beach, and at Powder Mill Lake. The study also indicates that disruptions of the bottom sediments will most likely increase the suspended load, increase contaminant transfer downstream and could increase toxic levels in parts of the biota.

How Metal Contaminants may Travel through the Environment


Rain can leach unweathered rock in mine tailings.
Arsenic and mercury can be washed into the lake.
lawn fertilizer
septic leachate
Metal-bearing sediment can be transported from upstream.
Construction may expose contaminants which can be washed away with surface run-off.
Contaminated sediment settles to the lake bottom.
Strong current agitates the water and can stir up sediment which is washed downstream.
Predatory fish can accumulate mercury and arsenic.
Construction disturbs the bottom and can release contaminated sediment.

What further work is being done

Studies of this kind, often tend to raise as many questions as they answer. Since the 1983-84 sampling, new work has been initiated to try to further our comprehension of arsenic and mercury pathways in the Shubenacadie headwaters area. For example, arsenic and mercury may exist in a number of forms or "species", some of which are more toxic than others. Thus some of the work now being undertaken is evaluation of metal speciation in some of the lakes, and the factors which control their presence. Other studies are looking at the invertebrates which are in a position to accumulate contaminants from sediments and which are then eaten by fish, to see if there are any potential linkages to those species consumed by humans.

Epilogue

With the work done up to now, some pathways for mercury and arsenic in the surface waters of the Shubenacadie Headwaters Lakes have been identified and to some extent quantified, and sources of concern have been identified. More is being done. For further information contact:

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Environment Canada
Queen Square
Dartmouth, N.S., B2Y 2N6
(902) 426-8374
or
Information Officer
Nova Scotia Dept.
of Environment
P.O. Box 2107
Halifax, N.S., B3J 3B7
(902) 424-5300

General Description of Montague Area

The locations of abandoned gold mines, mill tailings and waste rock dumps in the Waverley area are shown opposite. These sites are numbered and are described according to site number.

These areas have been extensively mined; Lakes William, Thomas, Powder Mill, and Muddy Pond have served as convenient disposal sites for mine waste generated from numerous mining companies. The shores and sediments of these lakes are now highly contaminated with arsenic, mercury and possibly cyanide.

Site 1 - This site served as a dump for mill tailings (sand). A store was located adjacent to and directly across the road from this tailings flat. Today, an Irving Oil Station is found on the tailings flat.

Site 2 - This area is part of Laidlaw Hill. Waste rock can be seen throughout the area which is now heavily wooded. An old cement foundation remains, this may have been the water power house, as shown on the Faribault map, adjacent to the road. Today, a few houses are built on this site and large areas of waste rock are still present. This area is located approximately .5 km (3/10 of a mile) north of the Irving Station.

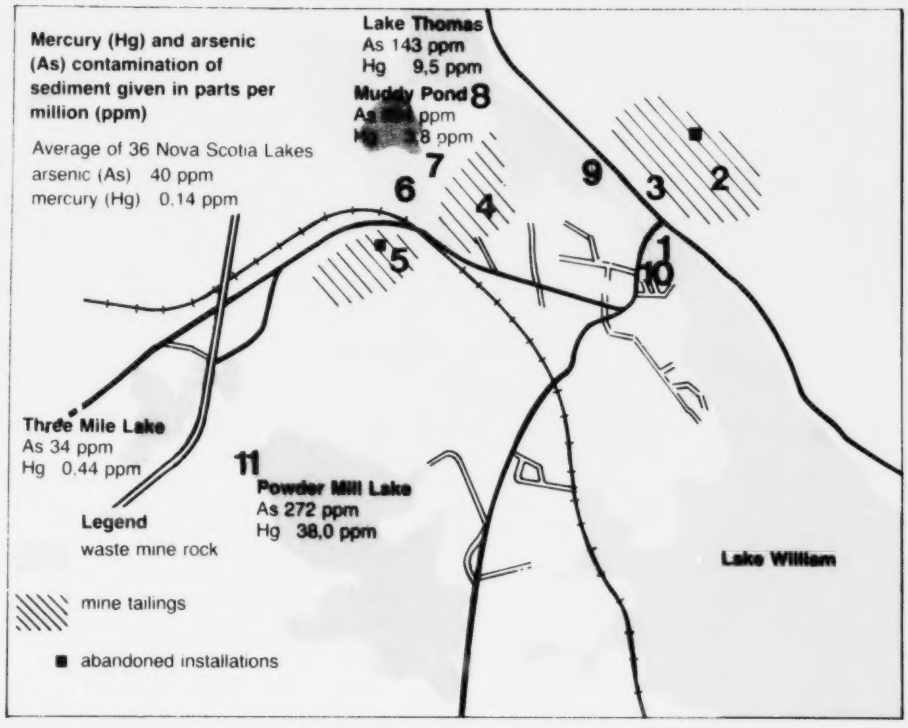
Site 3 - According to the 1901 Faribault map, this site (located at the outlet of Lake William) was the site for a stamp mill. This mill may have belonged to the Waverley Gold Mining Company which was reported in a June, 1893, paper to have obtained permission to dump mine waste into the mouth of the canal. Today, an ice cream store and automotive repair shop occupy the area.

Site 4 - This is the American Hill area. The bank adjacent to Muddy Pond is moderately wooded; with waste rock and quartz are scattered throughout. A few houses are built on this hill.

Site 5 - According to Faribault's 1901 map, this was the location of a 10 stamp crusher. One corner of its concrete frame still remains. Presently, this area is a large waste rock dump, the surrounding area being heavily wooded.

Site 6 - This is the site of a plastics fabricating plant .

Designated Sites in the Waverley and



Site 7 - Muddy Pond is a swampy area adjacent to waste rock (on the American Hill side) and has large visible quantities of mine sand on its banks. The report of one newspaper in June, 1893, said that mine tailings dumped into this pond by the West Waverley Gold Company was so vast that it raised the water level of the pond, causing the Lake View Mine to flood. After a process of litigation, it was agreed that the Waverley Company could dump its wastes along the shores of Lake Thomas (approximately 1,100 feet) and to use Muddy Pond "for any purpose whatsoever".

Site 8 - This site is a tailings flat that extends into the water and onto the shore of the western side of Lake Thomas.

Site 9 - Tailings sand extends along the eastern shore of Lake Thomas from the mouth of Lakes Thomas and William, approximately 350 metres up the shores of Lake Thomas.

Site 10 - This is a sand tailings site which borders the western side of Lake William.

Site 11 - This site is a large tailing sand area extending from the inflow of Power Mill Lake towards Three Mile Lake. Furthermore, information obtained from maps from the Nova Scotia Department of Mines indicated that small quantities of waste rock can be found around each mine shaft.

Fish (ppm)

	White Perch		White Sucker		Black Bass		Brook Trout	
	As	Hg	As	Hg	As	Hg	As	Hg
L. Thomas	0.07	0.84	0.02	0.56	0.03	0.95	–	0.35
Muddy Pond	–	–	0.151	0.39	–	–	0.03	–
Powder Mill	0.02	1.58	0.05	0.17	0.03	0.58	–	–
Lake William	0.02	0.77	–	–	0.03	0.67	–	–